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PHYSIOLOGICAL AND ANATOMICAL PRECONDITIONS IN CHRONIC PANCREATITIS PAIN TREATMENT

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Chronic pancreatitis usually presents with painful progressive destruction of the pancreas. Over 80 % of the patients complain of acute pain during the progression of the disease (1). This pain sometimes is so insufferable, that patients loose much time to control it and this leads to low quality of life. Even nowadays the question about etiology and pathogenesis of the pancreatic pain is still unclear, so is the right therapeutical strategy for this serious disease, causing loss of capacity of work.

Nociception of the pancreas

Even though the initial electrical impulse for starting the pain in patients suffering from chronic pancreatitis is unknown, there are some theories about the problem. In 1982 is established significant increasing of the pressure in main pancreatic duct in patients with chronic pancreatitis (4). This invention is confirmed and developed including significant increasing of the pressure in pancreatic parenchyma in these patients (5). One of the theories claims that the direct compression of the sensory nerves from the increasing parenchyma pressure is the reason for the pain and another - the stimulation of the corpuscles of Pacinian, which are situated in pancreatic parenchyma. Williamson et al. suggest that the increased pressure in the pancreas is the cause for "compartment syndrome", which leads to ischemia and parenchyma acidosis (6). Other mechanisms explaining the reasons for pancreatic pain include direct contact between sensory nerves and parenchyma neural irritating factors, generated from the disease. Keith et al. observe an eosinophile infiltration in pancreas parenchyma in patients with chronic pancreatitis and according to them this is due to waste products from the eosinophiles (7). Additional evidence to this "irritating "hypothesis" is the observations made by Bockmann et al., who demonstrates the lost of protective neurolema of the internal pancreatic sensory nerves in patients suffering from chronic pancreatitis (8).

Neuroanatomy

Pancreatic pain is usually felt in the epigastrium, left and right hypohondriums and corresponding regions of the back. Stimulating in the upper part of the human pancreas with an electrode causes pain most in the right part of the abdomen; stimulating in the central part causes pain on both sides of the abdomen and stimulating the pancreatic tale - in the left side.

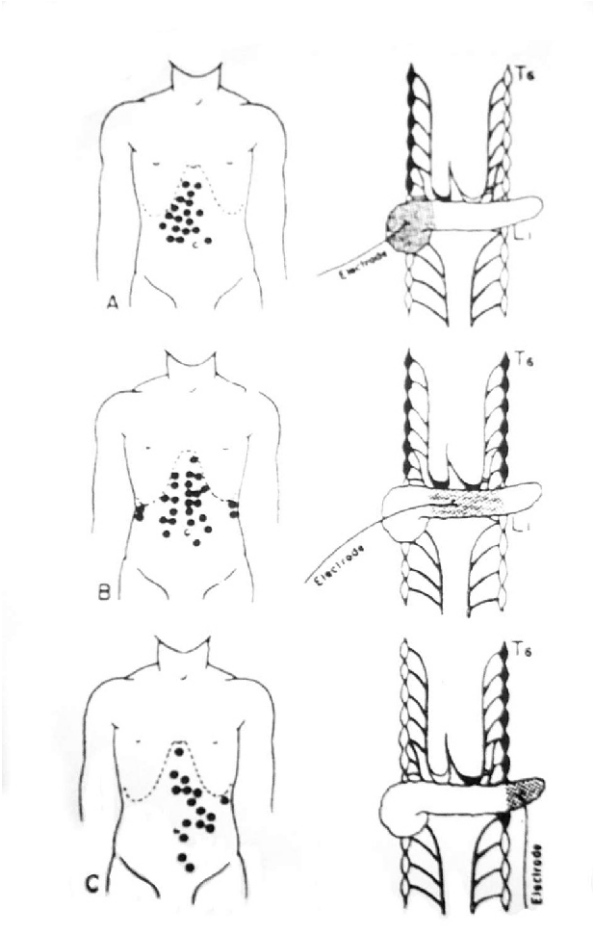

Fig.1: Electric stimulating of human pancreas of a patient in consciousness. A. Stimulating in the upper part of the human pancreas causes pain most in the right part of the abdomen. B. Stimulating in the central part cause pain on both sides of the abdomen and bilateral neural transmission. C. stimulating the pancreatic tale causes pain in the left side of the abdomen (Bradley).

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Afferent nerve fibers responsible for the pain, coming from the pancreas, pass to central nervous system in the composition with the sympathetic nervous fibers conducting motor efferent to the pancreas. Therefore breaking of these fibers leads to sensor and motor disturbance – for example decreased sensitivity and vasodilatation. Most of the sympathetic afferent nervous fibers responsible for the pain are without myelin sheath - they are 2 types: **"a"** (express reaction - 3-15 m/s) and **"c"** – (slow reaction – 0.7-2.3 m/s). Afferent fibers pass through celiac ganglion without synapse. Probably these crossing fibers are the reason for feeling the pain on both sides of the abdomen, although its origin is inside the pancreas. From there the afferent impulses pass through splanchnic nerves to sympathetic ganglion, next through the white ramus and corresponding somatic spinal nerve to the sympathetic acsonal cell body, situated in dorsal root Th5-Th10 (10). Acsons from cell bodies in dorsal root direct up and down around some vertebras of spinal cord, before entering in posterior horn of spinal brain. The different entrance levels to the spinal brain of afferent pain impulses can explain why breaking of single part of the dorsal root (dorsal risotomy) do not achieve adequate analgesia. The crossover of the afferent nerve pain fibers is typical for the spinal cord, but in the ånd all nociceptors synapse with secondary afferent neurons in posterior horn. Ascending pathways in ventrolateral part of spinal brain transfer nociceptive information from the pancreas to the cerebrum (10).

The great splanchnic nerve (GSN), composed mainly of myelin efferent pre-ganglion fibers and non myelin afferent

Tab. 1 Origin and frequency of highest and lowest root of GSN

Root	Highest root			Lowest root		
	Right	Left	All	Right	Left	All
Th2/3	-	-	-			
Th3	3	3	8%			
Th3/4	-	-	-			
Th4	7	9	24%			
Th4/5	2	1	4%			
Th5	12	19	44%			
Th5/6	1	1	3%			
Th6	5	3	12%			
Th6/7	-	-	-			
Th7	1	3	5%	1		1.4%
Th7/8				2		3%
Th8				1	4	7%
Th8/9				1	2	4%
Th9				13	14	38%
Th9/10				2	3	7%
Th10				12	14	37%
Th10/11						
Th11					1	1.4%
Th11/12						
Th12					1	1.4%
Th12/L1						
LI						

sensorial fibers, usually is formed by ramifications of Th5 to Th10 sympathetic ganglion. By analyzing 57 thoracoscopic splanchnicectomy (TSC) – 30 (53%) of them bilateral, performed and video documented in our clinic on the occasion of pain in upper part of the abdomen caused by supramesocolic neoplasms (engaging plexus celiacus), we establish:

- Location of the splanchnic nerves in all 30 bilateral thoracoscopic splanchnicectomy is asymmetric
- The great splanchnic nerve exists in all patients. On the right side it has often 5 roots – in 14 cases – 47% (fig.2), 9 cases – 4 roots (30%), 4 patients are with 6 roots (14%) and 3 cases with 7 roots (10%).

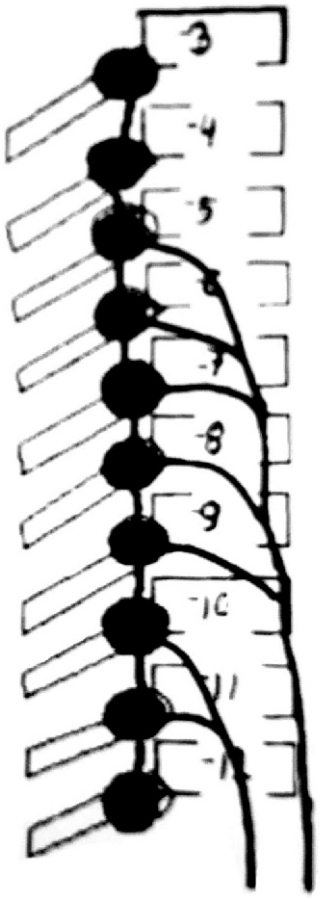

Fig. 2. Great splanchnic nerve with 5 roots

On the left side GSN has 4 roots – in 14 of 30 cases (47%), 5 and 3 roots respectively each in 6 patients (20 %), 6 roots in 3 patients (10%), and combining 7 roots in 1 patient (3%).

On the right side distal part of GSN pass near vertebral column, but on the left side it is closer to the vertebral column, lying directly on the descending aorta.

The highest ganglion giving onset of the splanchnic nerve in right thorax is the third ganglion in 3 cases, and in left thorax also the third ganglion in 3 cases. The lowest ganglion on the right is tenth one (14 patients), and on the left – eleventh and twelfth – each in 1 case.

In most cases (44%) the highest root of GSN starts from 5th thoracic ganglion (tab.1). In other the beginning is from 3rd ganglion. In 38 % the 9th thoracic ganglion originates the distal root of GSN. In only one case it starts from 12th thoracic ganglion. These observations relate to our operative strategy in performing thoracoscopic splanchnicectomy (TSC).

The both great splanchnic nerve fibers have ramifications to descending part of thoracic aorta. The basic part of nerve fiber passes through ipsilateral diaphragmal limb to the corresponding celiac ganglion and some fibers reach the aortorenal ganglion and suprarenal gland.

The little splanchnic nerve (LSN) is made from branches of 9th and 10th (sometimes 11th) thoracic ganglion and trunk formed from them passes through the diaphragm just under the GSN, finishing in aortorenal ganglion. At the time of cutting off the right little splanchnic nerve there is a risk for thoracic drain.

Rarely can be noticed the least (intermittent - ISN) of the splanchnic nerve fibers.

The question whether the vagus transfers some afferent sympathetic fibers is still controversial (13). Even though determination of the vagus as an additional sensory nerve has important consequences for defining type of procedures combined with the sensorial denervation.

The good knowledge of anatomy and physiology of the pancreatic innervation and the mechanism of pain in patients with chronic pancreatitis is the way to the appropriate treatment - conservative or surgical. Nowadays surgeons turn attention to miniinvasive techniques to overcome pain symptoms at the chronic pancreatitis the more so as they are not as harmful and dangerous as the resection and draining techniques.

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